CSE221 Data Structures (Fall 2016)
Instructor: Prof. Won-Ki Jeong
Due date: Oct 9, 2016, 11:59 pm.

Assignment 2: Simple Calculator using Stacks

In this assignment, you will implement a simple text-based calculator using a stack. You are required to modify/complete two files: `stack.txx` and `calculator.h`.

1. Stack class implementation (30 pts)

In stack.h, the stack abstract data type is defined. You will find function names as well as data. Actual implementation of those functions should be in stack.txx. You need to implement following functions:

- ~Stack() : destructor
- type& Top() : return the top element in the stack
- void Push(const type& item) : push an element to the stack
- void Pop() : delete the element at the top
- bool IsEmpty() : return true if the stack does not contain any element.

You need to use linear array to store element. You also need to dynamically adjust the size of array as needed (initial capacity is 10).

Note that you need to modify stack.txx, and this file is included in stack.h because stack is a template class (i.e., the implementation must be inlined).

2. Simple text-based calculator (70 pts)

Once you implement the stack data structure, you can implement a simple text-based calculator using stacks. You need to implement `double Eval(char* in)` function in calculator.h. This function accepts a C-string of an **infix** expression and returns the result. For example,

Input : 10 + (20 – (30+40))
Output : -40

The usage of this function is given in main.cpp as follows:

```
char str[] ="-10-((-2+(2+4*3))-12) + 122 * (123 +
(120+888) - 300)";

// The correct result is 101372
std::cout << "Result : " << Eval(str) << std::endl;
```

One way to implement the calculator for infix expression is first converting infix notation to postfix notation, and evaluating the postfix expression using stacks. (as discussed in the class).

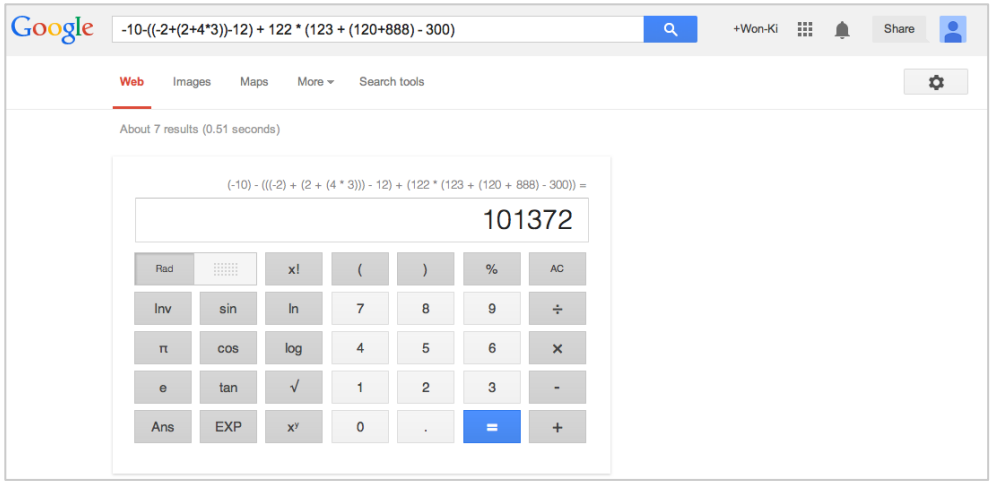
You can assume the following for the input expression:

1. There are **only five operators**, i.e., +, -, *, /, and unary minus.
2. There may be parenthesis in the expression, but the expression may **NOT** be fully parenthesized. For example, (2+3*5)+7 can be a valid input, although the fully-parenthesized expression is ((2+(3*5))+7).
3. Input strings may contain numbers, parenthesis, operators, and space **only**. Example: 10 + { 20 + 30 } is not allowed because { and } are not allowed to use.
4. You can assume that there will be **no** grammatical errors.
Example: 10 (20+30) is error because * between 10 and (is missing.

Make sure that unary minus operator works correctly. For example, -10+3, - in front to 10 is an unary operator (not a binary operator). In order to distinguish unary and binary operators, you need to check whether there is a number or) in front of -. Otherwise, - is an unary operator.

Examples:
10 – 2 : binary minus because 10 is in front of -.
(10 +5) – 8 : binary minus because) is in front of -.
(-10*5)+2 : unary minus because (is in front of -.

Once you finish implementation, check the correctness of your code by comparing the solutions using google (if you cut-and-paste the expression into google search window then google will give you the solution. See below.)



I also provide an example parser in the skeleton code. The given parser will parse the input string into numbers and operators, and push those into corresponding stacks. Feel free to modify this parser code for your own implementation.

3. Compile and submit

You must log in uni06~10.unist.ac.kr for coding and submitting the assignment. You can compile the code using the included Makefile. You can simply `make` and then the code will be compiled. The output executable name is `assign_2`.

Once you are ready to submit the code, zip stack.txx and calculator.h into assign2.zip and submit it using the `dssubmit` script as follows:

```
> dssubmit assign2 assign2.zip
```